

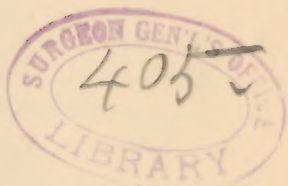
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THE
PHYSIQUE OF WOMEN IN MASSACHUSETTS.

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BY PROF. H. P. BOWDITCH, M.D.



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In the eighth annual report of the State Board of Health of Massachusetts was printed an article entitled, "The Growth of Children." In this paper were embodied the results of a study of the height and weight of school children of Boston and vicinity, about 24,500 measurements having been made, chiefly upon pupils of the public schools of the city. Tables and curves were given, showing the average heights and weights of school children from five to eighteen years of age, of both sexes, and of parentage of various nationalities. In a subsequent article, two years later, the same data were further discussed, with a view to ascertaining the relative importance of race and environment in determining the rate of growth.

In order to enlarge the body of statistics from which conclusions could be drawn, the State Board of Health, Lunacy and Charity, in 1880, issued the following circular:—

COMMONWEALTH OF MASSACHUSETTS.

STATE BOARD OF HEALTH, LUNACY AND CHARITY,
DEPARTMENT OF HEALTH, STATE HOUSE,
BOSTON, JAN. 1, 1880.

DEAR SIR:—As a contribution to the vital statistics of Massachusetts, the State Board of Health, Lunacy and Charity desires to suggest the importance of collecting observations upon the physique of the inhabitants of the State. The usefulness of such an investigation will be evident from a consideration of some of the problems upon which it will throw light. These may be briefly enumerated as follows:—

1. The influence of geographical and climatic conditions on the growth of children and on the physique of adults.

2. The number of generations necessary for the complete development of the influence of changed climatic conditions on the physique of a given race.

3. The comparative effect of city and country life on the growth and development of the human race.

4. The relation between diseases and the rate of growth.

5. The effect of local hygienic conditions on the physique of children and adults.

That the results of the inquiry may have the greatest possible value, it is desirable that measurements should be made upon individuals of all ages and of both sexes. In pursuance of this object, the Board will be glad to co-operate with superintendents of public institutions, both charitable and penal, with persons having facilities for making observations in factories and mills, with school committees, with principals of academies and colleges, with fathers of families, and with all who are interested in this branch of scientific investigation.

To secure uniformity of method, the Board will distribute gratuitously, to all who desire to assist in this research, blank cards, on each of which are to be recorded the statistical data relating to a single individual.

If you desire to aid in this investigation, you are requested to state the number and sex of the persons in regard to whom you will be able to collect any or all of the above-mentioned statistical data. The Board will then gladly supply you with the necessary number of blank cards, and furnish you with full instructions as to the best method of taking and recording the measurements. The use of the metric system for this purpose is attended by so many and such decided advantages, that the Board is willing, if desired, to furnish certain simple forms of apparatus to facilitate the work. If, however, it is for any reason impossible to employ the metric system, measurements recorded in inches and pounds will be gladly received, and the conversion afterwards made at this office.

The statistics collected in this way will be placed in the hands of Prof. H. P. Bowditch, to whose articles on the growth of children in the eighth and tenth reports of the State Board of Health, investigators in this field of research are referred.

In behalf of the State Board of Health, Lunacy and Charity,

Very respectfully yours,

CHARLES F. FOLSOM, M.D.,

Secretary.

To those who expressed a willingness to aid in this investigation blank cards were forwarded, printed on both sides, as follows:—

FEMALES.] FOR A SINGLE SET OF OBSERVATIONS.								SEE THE OTHER SIDE.	
Record all linear measurements at nearest centimeter; all weights at nearest kilogram.									
Name (or initials), _____					Age, _____ yrs. _____ mos.				
Height, without shoes, _____			Sitting height, _____			Finger reach, _____			
Chest girth, inspire, _____; expire, _____			Weight, (in ordinary in-door clothes) _____						
Nationality of	{	Father, _____		Color of Eyes, _____		Color of Hair, _____			
		Mother, _____		Birthplace, _____					
		Paternal Grandfather, _____		Occupation (of husband if a married woman), (of parents if a minor). _____					
		Paternal Grandmother, _____							
		Maternal Grandfather, _____							
		Maternal Grandmother, _____		Name (or initials) of observer. _____					
(This card when filled is to be returned to Sec. of State Board of Health, Lunacy and Charity, State House, Boston, Mass.) _____									

The Height is to be taken in an upright position, without shoes, the feet being close to the measuring rod. If, in the case of infants, it is necessary to measure in a recumbent position, the fact should be stated.

The Sitting Height is the vertical distance between the top of the head and the surface upon which the individual is seated.

The Finger Reach is the distance between the tips of the middle fingers when the arms are extended horizontally, the breast and arms being in contact with a wall.

The Chest Girth should be taken after a forcible inspiration and also after a forcible expiration, the measuring tape being passed horizontally round the chest on a level with the nipples, over only a single garment. This measurement is to be taken only on men and children.

The Weight is to be taken in ordinary in-door costume. In the case of children less than ten years of age, it is to be recorded at the nearest tenth of a kilogram.

The Color of the Eyes is to be recorded as blue, gray, brown or black.

The Color of the Hair is to be recorded as fair, golden, red, brown, black or gray. If gray, record also, if possible, the original color.

The Nationality is determined by the place of birth.

The Occupation should be given so as to indicate as far as possible the degree of comfort in which the individual lives.

See also article on "Anthropometrical Methods," tenth annual report Massachusetts State Board of Health, 1879, p. 55.

The advantages of this card method of collecting statistics are fully set forth in an appendix to the second of the above-mentioned articles.* To the explanations there given it need only be added that the short vertical lines, one centimeter apart, printed at the

* See tenth annual report of the Massachusetts State Board of Health, 1879, page 55.

top of the card, are intended to aid in marking the cards coming from any one institution or locality, so that they may be distinguished, when mixed with others, in sorting them with reference to any particular statistical inquiry. The marking was effected by screwing all the cards belonging to any one institution into a vise, and scoring the tops of them with a hand-saw at one or more of the vertical lines. A record being kept of the scored lines corresponding to each institution, it was always easy to identify the cards belonging to it.

The Board also authorized the construction of several sets of weighing and measuring apparatus which were sent to the different institutions in turn, in order to secure uniformity in the method of making the observations. By these means measurements were obtained in the following institutions, public and private, during the years 1881-85:—

NAME OF INSTITUTION.	NUMBER OF OBSERVATIONS.		NAME OF OBSERVER.
	Male.	Female.	
Wellesley College, . . .	—	302	Miss E. A. Nunn.
Mt. Holyoke Seminary, . .	—	203	A. A. Richardson, M.D.
Smith College, Northampton, .	—	92	Lucy B. Hunt.
Normal School, Westfield, . .	11	106	J. G. Scott.
Normal School, Bridgewater, .	39	129	A. C. Boyden.
Normal School, Worcester, . .	—	38	E. H. Russell.
Normal School, Framingham, .	—	65	Miss E. Hyde.
Practice School, Framingham, .	21	41	Miss E. Hyde.
Private School, Boston, . . .	—	40	Miss Selma Wesselhoeft.
Private School, Boston, . . .	—	35	Miss Ireland.
Private School, Boston, . . .	—	25	Miss Gibbens.
Reform School, Westborough, .	119	—	C. A. Robbins.
Reform School, Lancaster, . .	—	70	N. Parker Brown.
Reform School, Lancaster, . .	—	73	Miss Putnam.
Farm School, Boston, . . .	97	—	F. M. Barrett.
Conservatory of Music, Boston, .	—	127	S. L. Tourjée.
Almshouse, Tewksbury, . . .	37	200	Dr. Lathrop.
	324	1,546	

To the intelligent co-operation of the above observers the success which has attended the investigation is chiefly due.

The publication of the results of this research has been delayed in the hope that they might be embodied in a comprehensive treatise on anthropometry in Massachusetts; but

the pressure of other duties has thus far prevented the preparation of such a work, and there seems to be no probability that in the immediate future such a task can be undertaken. Moreover, anthropometrical investigations have, in recent years, been carried on under the auspices of Harvard College, on a larger scale and in a much more thorough manner than was contemplated when these data were collected. The development of the human physique in Massachusetts is, therefore, a subject the discussion of which may properly be postponed till the data, constantly accumulating in the hands of the Director of the Hemenway Gymnasium shall be numerous enough to enable him to draw positive conclusions upon the numerous questions to which his investigation is directed. It has, therefore, been decided to present a few of the most obvious results derived from the study of the data thus far collected, and to point out some of the questions to the solution of which they may contribute in the hands of future investigators.

It will be observed that, in the above list, the observations on females are much more numerous than those on males. This was due to a special effort to obtain statistics relating to the female sex, which, in most anthropometrical researches, has been strangely neglected, though in all questions relating to the growth and development of the race its importance is at least equal to that of the male sex.

With the exception of the observations made at the Tewksbury Almshouse, which were set aside for special study, and have not been incorporated in any of the following tables, the great bulk of all the data were collected from individuals between the ages of seventeen and twenty-four years. Now, at the age of seventeen years, most girls have nearly completed their growth, as will be seen by a reference to the curves on Plate I in the above-mentioned article on the growth of children, in the eighth annual report of the State Board of Health. It therefore seemed possible, by means of the data at our disposal, to obtain a fairly correct idea of the physical type of the adult young woman of this community. One thousand one hundred and seven cards were found to contain data suitable for this determination, and attention was at first directed only to the record of the

height, weight, sitting height and finger reach, or stretch of arms, as it may more properly be called. As these last two measurements are interesting chiefly for the light they throw on the proportionate development of different parts of the body, their absolute values are less important than their relation to the total height of the individual. As a preliminary to tabulation, therefore, the absolute values of the sitting height and stretch of arms on each card were converted into percentage values of the total height. The cards were then treated by the method described in the appendix to the above-mentioned supplementary article on the growth of children, published in the tenth annual report of the State Board of Health.

Although, for the determination of the physical type of the adult young woman, the observations were to be used without regard to the age or the institution to which the individual belonged, yet, with a view to some future possible utilization of the statistics, the cards were at first sorted with reference to both these points. Thus the first tabulation showed, for each age and for each institution, the number of individuals observed, at each centimeter of height, each kilogram of weight and each half per cent. of sitting height and stretch of arms. Tables 1 to 4 give the result of this first tabulation after the observations had been added together, without regard to age or the institution in which the observations were made. Thus Table 1 shows that, out of 1,107 women of seventeen years of age and upwards whose height was measured, one was 139, one 141, four 143 centimeters high, and so on. From a table of this sort the average height is easily calculated, by multiplying each height in centimeters by the number of observations recorded at that height, adding the products together, and dividing the sum by the total number of observations. Average values for the dimensions recorded in the other tables are obtained in a similar manner.

TABLE 1.

Showing Distribution of Observations on Height of Women in Massachusetts (Seventeen Years Old and upward).

Height in Centi- meters.	No. of Observa- tions.	Height in Centi- meters.	No. of Observa- tions.	Height in Centi- meters.	No. of Observa- tions.	Height in Centi- meters.	No. of Observa- tions.
139	1	149	15	159	75	169	12
140	—	150	28	160	64	170	13
141	1	151	29	161	81	171	3
142	—	152	36	162	68	172	4
143	4	153	45	163	56	173	—
144	4	154	59	164	49	174	5
145	2	155	65	165	56	175	—
146	6	156	59	166	44	176	1
147	8	157	73	167	21	177	1
148	12	158	86	168	21		

Total number of observations, 1,107. Average height (without shoes)
= 158.76 centimeters.

TABLE 2.

Showing Distribution of Observations on Weight of Women in Massachusetts (Seventeen Years Old and upward).

Weight in Kilograms.	No. of Observa- tions.	Weight in Kilograms.	No. of Observa- tions.	Weight in Kilograms.	No. of Observa- tions.	Weight in Kilograms.	No. of Observa- tions.
32	1	46	19	60	60	74	3
33	—	47	32	61	52	75	8
34	—	48	30	62	39	76	1
35	1	49	43	63	29	77	5
36	—	50	61	64	28	78	1
37	2	51	51	65	22	79	3
38	1	52	56	66	20	80	3
39	1	53	68	67	17	81	2
40	5	54	70	68	16	82	1
41	1	55	37	69	4	83	—
42	9	56	64	70	11	84	—
43	4	57	62	71	9	85	—
44	12	58	42	72	2	86	3
45	12	59	74	73	8		

Total number of observations, 1,105. Average weight (in ordinary
in-door costume) = 56.51 kilograms.

TABLE 3.

Showing Distribution of Observations on Sitting Height as Percentage of Total Height of Women in Massachusetts Seventeen Years Old and upward.

Per cent. of Height.	No. of Observa- tions.	Per cent. of Height.	No. of Observa- tions.	Per cent. of Height.	No. of Observa- tions.	Per cent. of Height.	No. of Observa- tions.
37.5	1	42.5	—	49.5	2	55.5	49
38.	—	44.	—	50.	6	56.	28
38.5	1	44.5	—	50.5	23	56.5	10
39.	1	45.	—	51.	44	57.	8
39.5	—	45.5	—	51.5	60	57.5	1
40.	1	46.	1	52.	119	58.	1
40.5	1	46.5	—	52.5	111	58.5	2
41.	—	47.	2	53.	156	59.	—
41.5	—	47.5	1	53.5	177	59.5	—
42.	—	48.	—	54.	121	60.	—
42.5	—	48.5	—	54.5	101	60.5	1
43.	—	49.	4	55.	73		

Total number of observations, 1,106. Average sitting height = 53.24 per cent. of total height.

TABLE 4.

Showing Distribution of Observations on Stretch of Arms as Percentage of Total Height of Women in Massachusetts Seventeen Years Old and upward.

Per cent. of Height.	No. of Obser- vations.	Per cent. of Height.	No. of Obser- vations.	Per cent. of Height.	No. of Obser- vations.
93.	3	98.5	34	104.	24
93.5	5	99.	30	104.5	22
94.	2	99.5	81	105.	15
94.5	3	100.	182	105.5	13
95.	8	100.5	118	106.	7
95.5	9	101.	56	106.5	3
96.	14	101.5	56	107.	5
96.5	10	102.	91	107.5	3
97.	26	102.5	88	108.	—
97.5	47	103.	46	108.5	1
98.	71	103.5	31		

Total number of observations, 1,104. Average stretch of arms = 100.54 per cent. of total height.

It will be observed that in Table 3 five of the observations are widely separated from all the rest, showing that five of the women who were measured had a sitting height from 37.5 to 40.5 per cent of their total height; while, with the exception of these five cases, the smallest percentage sitting height recorded was 46. This wide separation of a group of cases from the great mass of the observations suggests the influence of some abnormal cause of variation. It seems not improbable that in these cases some deformity (*e. g.*, spinal curvature) may have produced a great diminution in the sitting height; but, in the absence of any precise information on the subject, it has been thought best to include them in the table. Their effect upon the average percentage sitting height is inconsiderable. By rejecting them, this value is raised to 53.3 per cent., and thus becomes identical with the "median value," as will be shown below in Table 5.

It is evident that the arithmetical average represents but very imperfectly the series of observations from which it is calculated, since the same average value may be obtained from sets of observations differing very widely in their distribution. For instance, the two series of numbers 24, 25, 26, and 5, 25, 45, both give the average value 25. It is also evident that tables of distribution such as those above given are inconvenient, on account of their not being readily comparable with similar tables in which the total number of observations is different.

Various devices for overcoming these difficulties have been suggested by statisticians; but the scheme of "percentile grades" as proposed by Francis Galton, F.R.S., in 1885, and fully elaborated by him in his recent work on "Natural Inheritance,"* is perhaps better adapted than any other to display the results of a statistical inquiry, and to facilitate a comparison between various sets of observations. In this scheme are given values which are surpassed or un-reached by various percentages of the total number of observations. In Table 1, for instance, five per cent. of the total number of observations (*i. e.*, 1,107) is 55.35. Now, in this table, since the heights are recorded at the *nearest* centi-

meter, it is evident that each successive group includes the observations between the half centimeter below and the half centimeter above the height recorded in the table. By adding together the numbers in the successive groups, we find that the sum of all the observations, at heights up to 149.5 centimeters inclusive, is 53; and, by adding the next group of 28 observations, the sum 81 is reached. Now, since 55.35 is between 53 and 81, it is evident that the height below which five per cent. of the observations fall is between 149.5 and 150.5 centimeters. The exact height can readily be calculated by interpolation. Thus the fraction of a centimeter which is to be added to 149.5 to give the required height, is obtained by dividing 2.35 (*i. e.*, $55.35 - 53$) by 28 (*i. e.*, the number of observations at 150 centimeters). This fraction is 0.08; and therefore 149.58 centimeters is the height below which five per cent. and above which ninety-five per cent. of the observations fall. In a similar way, the heights corresponding to other percentages can be obtained, and a table constructed which presents in a very compact form the result of a large series of observations.*

Thus, in the first, fourth, seventh and tenth lines of Table 5 will be found the percentile distribution of the observations contained in tables 1, 2, 3 and 4 respectively; while in the second, fifth, eighth, ninth, eleventh and twelfth lines are introduced, for purposes of comparison, the results of similar observations made by Dr. D. A. Sargent,† director of the Hemenway Gymnasium, upon individuals of both sexes, in this community; and in the third and sixth lines are given the figures obtained by Galton‡ in his measurements of English women at the anthropometric laboratory in the international exhibition of 1884. In the lines numbered 1*a* to 6*a* the values given in the first six lines in centimeters and kilograms are reproduced in inches and pounds, to facilitate comparison with tables in which the English weights and measures are used.

* A geometrical method of determining the values corresponding to the various percentile grades is given by Francis Galton in an article on "Anthropometric Percentiles," *Nature*, Vol. 31, page 223.

‡ *Scribner's Magazine*, Vol. 172.

† *Natural Inheritance*, London, 1889, page 200.

TABLE 5.

	SUBJECT OF MEASUREMENT.	NAME OF OBSERVER.	Age.	Sex.	No. of Observa- tions.	Unit of Measurement.	VALUES AT THE UNDER-MENTIONED PERCENTILE GRADES.											
							5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
1	Height (without shoes),	Bowditch, .	17 years and upward,	F.	1,107	Centimeters,	149.58	151.52	154.01	155.78	157.44	158.77	160.37	161.82	163.67	165.82	167.72	
2	Height (without shoes),	Sargent, .	16-26 years,	F.	1,835	Centimeters,	150.1	151.9	153.9	155.9	157.5	159.1	160.5	162.0	164.1	166.6	168.4	
3	Height (without shoes),	Galton, .	23-51 years,	F.	770	Centimeters,	149.5	152.2	155.7	157.7	159.2	160.7	162.2	164.0	165.7	168.7	171.0	
4	Weight (in ordinary in-door clothes), .	Bowditch, .	17 years and upward,	F.	1,105	Kilograms, . . .	45.82	47.85	50.28	52.33	53.97	56.07	58.00	59.75	61.85	65.82	69.93	
5	Weight (without clothes),	Sargent, .	16-26 years,	F.	1,901	Kilograms, . . .	42.0	44.0	46.3	49.0	50.4	52.0	54.0	55.4	58.6	62.2	65.8	
6	Weight (in ordinary in-door clothes), .	Galton, .	23-26 years,	F.	276	Kilograms, . . .	46.3	47.7	49.9	51.7	53.6	55.4	58.6	59.9	61.7	64.5	67.6	
7	Sitting height,	Bowditch, .	17 years and upward,	F.	1,106	Per cent. of height,	50.87	51.43	52.05	52.54	52.95	53.30	53.61	54.01	54.51	55.17	55.70	
8	Sitting height,	Sargent, .	16-26 years,	F.	{ about 2,000 }	Per cent. of height,	50.6	51.1	51.6	52.1	52.4	52.7	53.1	53.4	53.9	54.4	54.9	
9	Sitting height,	Sargent, .	16-26 years,	M.	{ about 2,000 }	Per cent. of height,	50.2	50.5	51.1	51.6	52.0	52.2	52.6	52.9	53.3	53.8	54.3	
10	Stretch of arms,	Bowditch, .	17 years and upward,	F.	1,104	Per cent. of height,	96.77	97.57	98.58	99.68	100.02	100.36	100.92	101.83	102.46	103.47	104.79	
11	Stretch of arms,	Sargent, .	16-26 years,	F.	{ about 2,000 }	Per cent. of height,	97.0	97.9	98.8	99.7	100.3	100.8	101.3	101.9	102.9	103.8	104.5	
12	Stretch of arms,	Sargent, .	16-26 years,	M.	{ about 2,000 }	Per cent. of height,	99.1	100.0	100.9	101.7	102.2	102.8	103.4	104.0	104.8	106.0	106.8	
1 a	Values of line 1 converted into,					Inches,	58.9	59.7	60.6	61.3	62.0	62.5	63.2	63.7	64.5	65.3	66.0	
2 a	Values of line 2 converted into,					Inches,	59.1	59.8	60.6	61.4	62.0	62.6	63.2	63.8	64.6	65.6	66.3	
3 a	Values of line 3 converted into,					Inches,	58.9	59.9	61.3	62.1	62.7	63.3	63.9	64.6	65.3	66.4	67.3	
4 a	Values of line 4 converted into,					Pounds,	100.9	105.0	110.8	115.3	119.0	123.7	127.9	131.7	136.2	145.0	154.1	
5 a	Values of line 5 converted into,					Pounds,	92.6	97.0	102.0	108.0	111.0	114.6	119.0	122.0	129.0	137.0	145.0	
6 a	Values of line 6 converted into,					Pounds,	102.0	105.0	110.0	114.0	118.0	122.0	129.0	132.0	136.0	142.0	149.0	

The figures in the column headed 50 per cent. give the measurements which are exceeded by one half and not reached by the other half of the individuals measured. These values are termed by Galton "median values" (or M) and are considered by him (at least in the observations which he discusses) as practically the same as the arithmetical means or averages.* It will be observed that in Table 5 the median values do not differ materially from the average values given in tables 1, 2, 3 and 4. The median and the average values of the height and sitting height are almost identical; while in the case of weight and stretch of arms, the median values fall somewhat short of the averages.

It is evident that, when the values at the lower percentile grades fall short of the median value by *the same amount*, the values at the higher percentile grades exceed it (or, in Galton's words, when "the curve of the scheme is symmetrically disposed on either side of M "), the median and average values will be identical. When, however, the *lower* percentile values fall short of the median value *more* than the higher percentile values exceed it, the average will be less than the median value; while a difference in the opposite direction will cause the average to exceed the median value. The difference between the median and the average value, or, as we may express it, the value $M - A$, becomes, therefore, a convenient indication of the direction and extent of the asymmetry of the curve of percentile distribution.

The interesting results which may be expected from an application of this method of discussion to the data already collected relating to the growth of children, will be presented in a future article.

An important feature in a table of percentile distribution, like Table 5, is found in the facility which it affords for determining the rank of an individual among others of the same class. Suppose, for instance, that a woman belonging to the class whose heights are given in the first line of Table 5, desires to know how her height compares with that of the other women measured. Suppose her height to be 160 centimeters. The table shows at once that this height exceeds

* Natural Inheritance, page 41.

that of 50 per cent., but does not exceed that of 60 per cent., of the women measured; and a simple sum in proportion shows that 160 centimeters corresponds to about 57.7 per cent. In other words, the woman in question, if ranked according to height, would stand about 577th in a group of 1,000 women selected at random.

Let us now consider what conclusions can be drawn from a comparison of the measurements described in this paper with those of other observers, as recorded in Table 5.

HEIGHT.

It will be observed, in the first place, that the heights recorded in the first line are slightly inferior to the corresponding measurements by Dr. Sargent, as given in line 2; while the figures in line 3, given by Mr. Galton as the result of his measurement of English women, are somewhat in excess of those obtained on this side of the Atlantic. In explanation of these differences, it may be said that the American measurements, having been taken upon women as young as sixteen or seventeen years, probably include a certain number who, being of slow growth, have not yet attained their full height; while the English measurements, being limited to women between twenty-three and fifty-one years, represent more accurately the adult height of the female portion of the community. It is also possible that we are dealing here with a difference of race, though the close correspondence which has been shown to exist between the heights of growing boys of the two nationalities does not support this view.

It is, furthermore, interesting to note that the difference between the heights at the fifth and the ninety-fifth percentiles is greater for the English than for the American women; being 21.5 centimeters for the former and 18.1 centimeters for the latter. It will be convenient to term this difference the *range* of the heights, though it of course indicates the range of only nine-tenths of the whole number of observations, the highest and lowest 5 per cent. being omitted. It will also be observed that the difference in height between the women of the two nationalities increases with tolerable regularity, as we ascend the series of percentile grades, from — 0.8 to 3.28 centimeters.

The slight excess of Dr. Sargent's measurements over our own is probably to be explained by the fact that the former were taken in schools frequented by the children of the most favored classes, while the latter include a certain number of individuals who had not grown up in the midst of comfortable surroundings.

WEIGHT.

The weights given in the fourth line of Table 5 are seen to be considerably in excess of Dr. Sargent's figures in line 5, owing to the fact that the latter represent net weights, while our own observations were made upon women "in ordinary in-door clothing." The excess at most of the grades amounts to 3.3-4.0 kilograms (8-9 pounds), — a difference which corresponds very well to the weight of clothing of the older girls, as given in Table 25 of the article on the growth of children, already alluded to.

A more accurate comparison may be made between our own observations and those of Mr. Galton (line 6), since the latter were also made upon individuals in ordinary in-door clothing. It will be observed that the range of the weights is greater in American than in English women, there being between the fifth and the ninety-fifth percentile grades a difference of 24.1 kilograms for the American and 21.4 kilograms for the English women. It will be also noticed that at most of the percentile grades the weight of the American exceeds that of the English women, the difference being most marked in the highest percentiles. This observation, in connection with the one above noted with regard to heights, seems to show that there is little difference between the shortest as well as between the lightest women of the two nationalities; but that the tallest English women surpass the tallest American woman in height, while the heaviest American women exceed in weight the heaviest English women. Before this conclusion can be accepted as absolutely established, it will be necessary to determine how far the greater age of the English women has affected the result. In other words, we must ascertain more accurately than is at present possible, at what age the growth of women, both in height and weight, can be regarded as completed.

SITTING HEIGHT.

A comparison of the figures in the seventh and eighth lines of Table 5 shows that the ratio of the sitting height to the total height is somewhat greater in our measurements than in those of Dr. Sargent, the median value being 53.3 per cent. in the former, and 52.7 per cent. in the latter. This difference is doubtless associated with the superior height of the women measured by Dr. Sargent, in a manner which will be presently explained. For purposes of comparison, Dr. Sargent's measurements of the sitting height of men are given in the ninth line of Table 5; and it is interesting to notice that they are lower than the corresponding measurements of women at all the percentile grades. In other words, women appear to be relatively longer in the body and shorter in the legs than men. Whether this is a sexual peculiarity, or whether it depends upon the fact that men are, as a rule, taller than women, is a question which can be settled only by a comparison of the percentage sitting height of a large number of men and women of the same total height.* It is a good illustration of the readiness with which the card method of recording statistics lends itself to the solution of problems which may arise subsequently to their collection, that the data already on hand can be made to contribute to the settlement of the question thus suggested.

In the first place, in order to obtain a set of statistics as comparable as possible with those of Dr. Sargent, those observations only were selected for discussion which were made in schools and colleges on women of seventeen years of age and upwards. Ten hundred and fifty-eight cards were found to contain records of this sort. These cards were then sorted according to the height of the individuals, the measurements falling within each successive set of 5 centimeters being brought into a single group. The cards in each group were then sorted according to the percentage sitting height, as shown in Table 3, and the percentile distribution of the observations in each group calculated in the manner above described. The results of this calculation are given in Table 6.

* Ranke (*Beiträge zur Anthropologie und Urgeschichte Bayerns* VIII. 56) regards the relatively greater length of the body in women as a proof that the female sex stands embryologically on a lower level than the male.

TABLE 6.

Table Showing Percentile Distribution of Observations on Ratio of Sitting Height to Total Height in Women of Seventeen Years and upward, arranged in Groups according to Total Height.

VALUES AT UNMENTIONED PERCENTILE GRADES.													
Height, Centi- meters.	No. of Observa- tions.												
		5	10	20	30	40	50	60	70	80	90	95	
1	145-149	43	52.29	52.80	53.34	53.58	54.05	54.44	54.68	55.06	55.49	55.93	56.67
2	150-154	184	51.59	52.20	52.79	53.19	53.51	53.81	54.09	54.41	54.81	55.34	55.81
3	155-159	343	51.29	51.67	52.14	52.72	53.13	53.53	53.88	54.16	54.65	55.21	55.65
4	160-164	303	50.70	51.34	52.03	52.49	52.86	53.10	53.34	53.56	53.91	54.56	54.99
5	165-169	155	50.52	50.89	51.36	51.84	52.10	52.35	52.59	53.00	53.49	54.03	54.50
6	170-174	23	47.32	48.20	50.45	50.99	51.31	52.08	52.43	52.66	53.31	53.70	54.17

An examination of this table shows that the ratio of the sitting height to the total height at all the percentile grades decreases as the total height increases. In other words, tall women differ from short women less in the length of the body than in the length of the legs. That this is also true of men, there is no reason to doubt; but whether the ratio in question varies with the sex as well as with the height of the individual, is a question to be settled by a comparison of the values in Table 6 with those to be obtained by a similar discussion of Dr. Sargent's observations on men. In his dis-

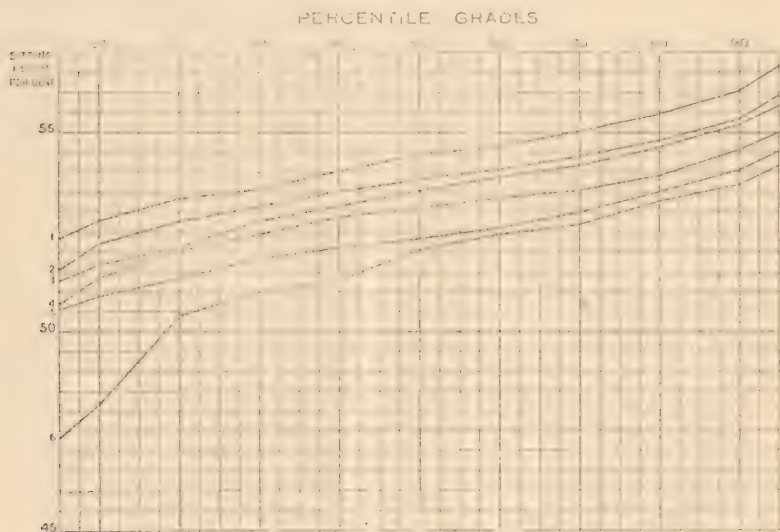


FIG. 1. CURVES, CONSTRUCTED FROM TABLE 6.

cussion of the anthropometrical differences between boys and girls, Dr. Sargent, in the above-mentioned article, points out that, at the age of fifteen years, boys are superior to girls in height, mainly on account of the greater length of the thigh bone. It would be of great interest to determine, by a further discussion of his observations in the manner above indicated, whether a disproportionate increase in the length of this portion of the body is mainly responsible for the differences in height between individuals of the same sex.

The way in which the ratio of the sitting height to the total height varies with the total height, may perhaps be

better understood from an examination of the curves in Fig. 1, which have been constructed from the figures in Table 6. The abscissas represent the successive percentile grades, and the ordinates the corresponding values of the ratio. It will be observed that the curves, which represent in order from above downward the values in the successive lines of the table, are in a general way parallel to each other; with the exception, however, of the lowest curve of all, which, being constructed from only twenty-three observations, is, of course, much less accurate than the others. These curves show very clearly, that, with an increase of height is generally associated a relative diminution of the sitting height, and thus furnish a sufficient explanation of the fact above referred to, — that Dr. Sargent's measurements give a lower relative sitting height than our own. They show also, that, when the observations are arranged in groups according to the value of the total height, there is in each group a large range in the value of the relative sitting height; so that a certain number of women in the tallest group sit relatively higher than certain other women in the shortest group. For instance, a relative sitting height of 53.3 per cent. is surpassed by 20 per cent. of the women in the tallest group, while it is not reached by 20 per cent. of those in the shortest group.

STRETCH OF ARMS.

It is popularly supposed that the distance between the finger tips when the arms are horizontally outstretched, is equal to the total height. An examination of the figures in the tenth, eleventh and twelfth lines of Table 5 shows that this is much more nearly true for women than for men; the median values in Dr. Sargent's observations being 100.8 per cent. for women, and 102.8 for men. Our own observations give at nearly all percentile grades slightly lower values than those of Dr. Sargent, — a difference which it seems reasonable to associate with the somewhat superior height of the women measured by Dr. Sargent; for, as we have just seen, tall individuals differ from short ones more in the length of the legs than in that of the body, and length of arms is generally associated with length of legs. A dis-

cussion, similar to that of the sitting height as above given, showing how the ratio of the arm-stretch to the height varies with the height, would, of course, settle the question; and a further discussion of Dr. Sargent's observations would also determine how far the superior ratio of the male sex is dependent upon a greater length of arms, and how far the greater breadth of the shoulders contributes to the result. In both sexes it will be observed there is a range of 7 or 8 per cent. between the fifth and ninety-fifth percentile grades.

It is evident that the data already on hand may be made to contribute to the solution of various questions connected with the physical development of the human race in Massachusetts; and that, with a further increase of the body of statistics, light will be thrown upon a variety of anthropological problems, especially those relating to the effect of race and environment on the physique of the individual. The systematic collection of such statistics in the public institutions of the State, would, in a few years, furnish data of inestimable value for the hygienist and the educator, as well as for the anthropologist and the statesman.

In conclusion, I desire to express my thanks to Miss Mary P. Nichols and to Miss Lucy R. Bowditch for much valuable assistance in the computation of tables.



